

Serial No. 10/518,491

H&A-136

Amendment

Responsive to Office Action dated February 2, 2007

REMARKS**Pending Claims**

Claims 1-5, 8-17, and 19-23 remain pending in this application. Claims 2, 7 and 18 have been canceled without prejudice or disclaimer. Claims 1-5, 8-17, and 19-23 have been amended. No new matter has been added.

Claim Rejections Under 35 U.S.C. §112

Claims 19-23 have been rejected under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claims 19-23 have been amended to delete the limitation "direct injection" in line 2 of each claim. Accordingly, the rejection should be withdrawn.

Claim Rejections Under 35 U.S.C. §102

Claims 1-5 and 8-11 have been rejected under 35 U.S.C. §102(b) as being anticipated by Yunoki et al., JP-8303325. Applicants request reconsideration of the rejection for the following reasons.

According to the present invention, a control unit 515 is a control device of a high-pressure fuel pump of a direct injection internal combustion engine 507 having a fuel injection valve 54 provided on a cylinder 507b and a high-pressure fuel pump 1 for pumping fuel to the fuel injection valve 54. As shown in Figs. 3 and 4, the high-pressure fuel pump 1 has a fuel inlet 10 and an inlet valve 5 through which fuel flows into the pressure chamber 12. A plunger 2 pressurizes the fuel in pressure chamber 20 and discharging the fuel through discharge valve 6 to the discharge passage 11. An actuator 201, through the force of a valve

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opening spring 202, normally pushes inlet valve 5 into the open position to allow fuel to flow into the chamber 20. Between when the plunger 3 reaches bottom dead center and top dead center, the phase of which is controlled in order to realize the variable discharge or pressure of the high-pressure fuel pump 1, inlet valve 5 is closed and the passage of fuel through inlet passage 10 is cut off. In particular, an ON-signal from the solenoid driving means 707 (Figs. 7 and 10) causes solenoid 200 to be energized, thereby counteracting the pushing force of the actuator on inlet valve 5 to cut off the inlet fuel flow to pressure chamber 20.

The control device has pump control signal calculating means 1502 that controls the ON-signal of the solenoid driving means and the end timing thereof so that there remains no attraction force of the solenoid 200 in the next discharge stroke of the high-pressure fuel pump 1. See Fig. 27 describing the problems with the prior art in which the end timing is such that there remains an attraction force of the solenoid 200 into the next discharge stroke of the high-pressure fuel pump 1 (fourth discharge stroke as shown in the figure). For example, as shown in Fig. 27, the measured fuel pressure exceeds that of the target fuel pressure even though a decrease in fuel pressure is targeted, because the pump discharges the whole amount of fuel due to the timing of the solenoid control signal with respect to top dead center and the discharge stroke.

As shown in Fig. 5, on the other hand, the solenoid control signal 1802 is operated with an end timing between bottom dead center and top dead center. By the present invention, the pump control signal calculating means 1502 is capable of preventing the high-pressure fuel pump 1 from discharging an amount of fuel that is unintended, and is also capable of preventing the solenoid output signal from being outputted in a phase incapable of pumping the fuel, i.e. a phase outside of bottom dead center and top dead center of the plunger.

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Claim 1 has been amended to clearly set forth that the control device has a control unit that sends a drive signal having a start phase and an end phase to an actuator for operating the inlet fuel valve to cut off fuel flow to the pressure chamber in combination with means for calculating the end phase of the drive signal with respect to a first predetermined phase. Further, claim 1 sets forth that the end phase calculating means sets the end phase to be the calculated end phase when the calculated end phase is on an advanced side of the first predetermined phase, and sets the first predetermined phase as the end phase when the calculated end phase is on a delayed side of the first predetermined phase.

Claim 8, which depends from claim 1, has been amended to set forth that the control unit also comprises means for calculating the start phase of the drive signal to the actuator with respect to a second predetermined phase wherein the means for calculating the start phase of the drive signal sets the calculated start phase as the start phase when the calculated start phase is on a delayed side of the second predetermined phase, and sets the second predetermined phase as the start phase when the calculated start phase is on the advanced side of the second predetermined phase. The remainder of the amended claims have also been amended to enhance their clarity. As amended, claims 1-5 and 8-11 are patentable over the art of record.

The Examiner relies upon JP-8303325 for disclosing the controlling of fuel flow with the control valve for a high pressure fuel pump. However, Japan '325 discloses that the electricity is cut when the pressure in the pump house becomes higher than the energized force in the opening direction of the valve, during the phase before the plunger reaches top dead center, after the flow control valve has been energized. Accordingly, Japan '325 simply cuts the electricity when the pressure before the plunger reaches top dead center becomes greater than the energized force. On the other hand, the present invention does not limit the

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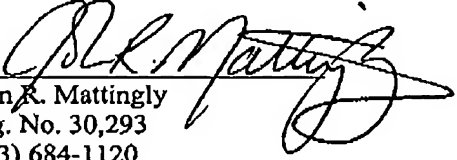
end timing of the drive signal at the predetermined phase, but rather at a calculated phase from the operation condition of the engine when the calculated end phase is on the advanced side of the predetermined phase. Further, Japan '325 does not recognize the problem of unexpected total discharge when the drive signal terminates later than the predetermined phase, and therefore the disclosure of Japan '325 is not sufficient to teach or suggest the present invention. Accordingly, withdrawal of the rejection of claims 1-5 and 8-11 under 35 U.S.C. § 102(b) is respectfully requested.

Conclusion

In view of the foregoing, Applicants respectfully requests that a timely Notice of Allowance be issued in this case.

Respectfully submitted,

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Date: July 2, 2007